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Julia Wolfson
Department of Health Management and Policy
University of Michigan

Noura Insolera
Institute for Social Research
University of Michigan

Alicia Cohen
Department of Family Medicine
University of Michigan

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Author correspondence
Julia Wolfson, jwolfson@umich.edu

University of Kentucky Center for Poverty Research, 550 South Limestone,
234 Gatton Building, Lexington, KY, 40506-0034
Phone: 859-257-7641. E-mail: ukcpr@uky.edu
www.ukcpr.org
EO/AA

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Principal Investigator
Julia A. Wolfson, PhD MPP
Department of Health Management and Policy
University of Michigan School of Public Health
1415 Washington Heights, SPH II M3240
Ann Arbor, MI 48103
734-764-6036
jwolfson@umich.edu

Co-Investigators
Noura Insolera, PhD
Institute for Social Research
University of Michigan

Alicia J. Cohen, MD MSc
Department of Family Medicine
University of Michigan

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ABSTRACT

In this report we present results from our study of the effect of SNAP and WIC participation during childhood on food insecurity risk in young adulthood. We also examined the effect of parental nutritional knowledge and childhood food involvement on food insecurity in young adulthood. We used data from the Panel Study of Income Dynamics Original Childhood Development Supplement. Our balanced panel (n=1,305) was comprised of individuals who were 0-12 years old in 1997, had data on SNAP and income from their year of birth through 2015, food insecurity data in 2015/2017, and had moved out of their parents' home and started their own household prior to 2015. We estimated logistic models using sample, cluster and strata weights to generate nationally representative results. We find a small, but non-statistically significant effect of SNAP and WIC participation during childhood on odds of being food insecure during young adulthood. When examining change in food security from 1999-2015, we find that participation in SNAP during ages 0-5 years (OR 2.36, 95% CI: 0.99, 5.61), and during ages 12-18 years (OR 2.68, 95% CI: 1.09, 6.57) is associated with a higher odds of being more secure in 2015 than in 1999 compared to low income children who were eligible for, but did not participate in SNAP. Participation in both SNAP and WIC during ages 0-5 predicts higher odds (OR: 4.47, 95% CI: 2.04, 9.78) of being more secure in young adulthood than in childhood compared to low income children who were eligible for, but did not participate in SNAP or WIC. Finally, we saw a statistically significant protective effect of high parental nutritional knowledge (in 1999) and child time spent preparing food (during ages 5-12) on food insecurity risk in 2015-2017. SNAP and WIC, as well as parental nutritional knowledge and childhood food involvement appear to have some protective effect on food insecurity in young adulthood. Future research should further investigate the effects of nutrition education, nutrition assistance program participation, and involvement in food preparation on food insecurity over the short- and long-term.

Introduction

In 2017, in the United States, 12% of the population was food insecure, including 16% of households with children.[1,2] The Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), two of the largest federal nutrition programs, aim to improve nutrition and food security among low-income Americans.[3,4] One in eight Americans receives SNAP benefits and one in two children born each year receive WIC benefits.[3,4] While evidence suggests that SNAP and WIC participation improves short-term food security at the time benefits are received, the effect of program participation on long-term food security is unknown.[5-12]

Nutritional knowledge is an important predictor of diet quality and healthy weight outcomes, however less is known about the relationship between nutritional knowledge and food security.[13-16] Nutritional knowledge, and participation in programs (such as WIC and SNAP-Ed (the educational program of SNAP)) may improve low-income families' ability to not only consume a healthier diet, but also to more efficiently manage limited food resources thereby resulting in improved food security.[17-19] Similarly, involvement in food preparation during childhood may build cooking skills and confidence that are important for improved management of food resources (including meal planning, shopping, and budgeting) facilitating improvements in dietary quality and overall nutritional status.[20,21] More knowledge in this area is important as evidence suggests that strong cooking skills are associated with higher food security.[22] Improved understanding of whether SNAP and WIC participation supports food security over the long-term is a key area of inquiry given the size and scale of both programs and the high prevalence of food insecurity among low-income Americans.

In this research, we examined whether participation in SNAP and/or WIC during childhood protected against food insecurity in young adulthood. Informed by Life Course Theory,[23,24] we also examined whether parental nutritional knowledge or child involvement in

food preparation positively influences food security status in young adulthood. Below, we describe our methods, results, and our next steps.

Research methods

We set out to answer three main research questions:

1) Is participation in SNAP and/or WIC during childhood protective against long-term food insecurity?
2) Does parental nutritional knowledge mediate the relationship between SNAP/WIC participation and food insecurity?
3) Does childhood food involvement protect against food insecurity in young adulthood?

We hypothesized that SNAP and WIC participation during childhood would result in lower odds of food insecurity in young adulthood. We also hypothesized that higher parental nutritional knowledge would amplify the potential positive effect of SNAP on long-term food insecurity. Regarding the role of childhood food involvement, we hypothesized that greater involvement with food shopping, cooking and mealtimes during childhood would lead to greater food security in young adulthood.

Data

Data were obtained from the Panel Study of Income Dynamics (PSID). PSID is the world's longest running nationally representative household panel survey. Data collection began in 1968 and has followed the original sample and their families since that time. For this study, we used data from the Childhood Development Supplement (CDS) which, starting in 1997 collected additional information about children aged 0-12 years old in 1997 and in follow-up waves in 2002 and 2007. To construct the analytic sample, we created a balanced panel of individuals from the CDS who had SNAP and income information from their family units from their year of birth through 2015 (n=2,394). We then limited the sample to individuals who were living on their own in 2015 as a head/spouse/partner of their own family unit (n=1,305). For research question 3, we used a sub-sample of 1,049 individuals who also had time diary information on food shopping, preparation and eating activities.

Measures:

Food insecurity: The outcome for all analyses was food insecurity in 2015 and/or 2017. Food insecurity was measured using the USDA 18-question food insecurity module, which is scored to create a four-category food insecurity measure: high food security, marginal food security, low food security or very low food security. We then created a binary measure of food security in which family units were classified as food insecure if they had low or very low food security, and food secure if they had marginal or high food security. 2017 data were obtained from the early release file (released January 2018) and do not include imputations or weights.

Food insecurity was also measured in the PSID in 1999, 2001, and 2003. We created binary measures of whether or not individuals were food insecure (low or very low food security) in each of those waves (based on their family level food security measure). We then consolidated those measures into an indicator of whether or not an individual was food insecure in any of the three data collection waves from 1999-2003.

In addition, we created two binary measures of the change in food security status from 1999-2015. First, we coded a person as having become *more secure* if they improved food security status (e.g. moved from having low food security in 1999 to having moderate or high food security in 2015). For this variable, people were coded as 1 if they were more secure and 0 if their food security status worsened or stayed the same. We coded a person as being *less secure* if their food security status declined from 1999 to 2015 (e.g. they moved from being moderately food secure in 1999 to having low or very low food security in 2015). In this case, individuals were coded as 1 if they were less secure and 0 if their food security status improved or stayed the same.

SNAP participation: SNAP participation is measured in all years. We examined SNAP participation in two ways. First, we used the question “Did you (or anyone in your family) use government food stamps at any time in [previous year]?” to create binary variables for whether

or not a family received SNAP benefits in the prior year, which is available for waves 1994-2015. We then created a binary measure of whether an individual's family received SNAP benefits at any time between 1999-2003. Next, we used data from 1984-2013 to code whether or not individuals received SNAP benefits at different stages of childhood. For years 1984-1992 a binary indicator of SNAP participation was created from the question "For how many months did you use food stamps in [previous year]?" We created three binary SNAP participation indicator variables for whether or not an individual's family received SNAP benefits at any point when they were 0-5 years old, 6-11 years old or 12-18 years old, in order to capture SNAP receipt in early, middle, and late childhood.

WIC participation: In CDS, Primary Caregivers (PCGs) are asked whether *that child* received WIC benefits in the PCG-Child Interview. They are asked whether they received benefits when pregnant with that child, as well as during childhood. WIC is only available to children aged 0-5 years, so we created a binary indicator of whether or not that individual received WIC at any point when they were 0-5 years old. We also created a four-category variable to capture whether individuals received benefits from (1) SNAP only, (2) WIC only, (3) both SNAP and WIC, or (0) neither SNAP or WIC, when they were 0-5 years old.

Low income status: We defined low-income as their total family income being ≤200% of the federal poverty level (FPL), and similar to SNAP participation, created binary measures of whether or not an individual's family was low-income at any point between 1999-2003, and whether or not they were low-income at any point during different age periods of childhood (0-5 years, 6-11 years, 12-18 years).

Parental nutritional knowledge: In the 1999 data collection wave, parents were asked five questions to assess nutritional knowledge about fat, fiber, calcium, cholesterol, and overweight status being linked to health problems. This set of questions was based on questions from the Diet and Health Knowledge Survey (DHKS).[25] We coded responses to these five questions as correct or incorrect then summed the correct responses to create a continuous

nutritional knowledge score. We also created a three-category nutritional knowledge variable in which 1= a score of 0 or 1, 2= a score of 2 or 3, and 3= a score of 4 or 5.

Childhood food involvement: Time diaries were collected for children in the CDS in 1997, 2002 and 2007. We used time diary information to generate the number of minutes per week children were involved in food shopping, food preparation (including meal preparation, serving food, doing dishes, and cleaning up) and eating. Time diaries were completed for one weekday and one weekend day, and only those who had completed both time diaries were included in this sub-sample. We used the primary activity codes to generate minutes per weekday and minutes per weekend day in these three activities. We then multiplied the weekday amount by five and the weekend amount by two to create an estimated weekly measure of time spent in each activity. We created three category measures of spending (1) no time, (2) a low (below the mean) amount of time or (3) a high (above the mean) amount of time for food preparation and food shopping, where cut points for low or high were based on the weighted mean for each among those who spent >0 minutes in the activity. Time spent eating was divided into weighted quartiles.

Other covariates included individual- and family-level measures. Individual-level measures included age in 2015 (continuous), sex, race (non-Hispanic White, non-Hispanic Black, Hispanic, other), marital status in 2015 (married, never married, divorced or widowed), educational attainment in 2015 (less than high school, high school/GED, some college, college plus), employment in 2015 (employed, unemployed, out of the labor force, non-working student), and time since 'launch' (i.e. the wave in which the individual split-off from the parental family unit). Family-level covariates not already mentioned above included log of total family income in 2015, region of residence in 2015 (Northeast, South, Midwest, West), metro/non-metro status in 2015, and family unit size in 2015.

Analysis

To generate nationally representative estimates and account for sample attrition, clustering, and strata, all analyses used PSID provided 2015 longitudinal survey weights. First, we used cross tabulations to examine transitions into and out of SNAP participation and food insecurity across the study period. We estimated logit models in which the outcome was food insecurity status in 2015/2017. The basic model specification (Model 1) is below:

$$\text{Model 1: } Logit\ (\pi_{FI}) = \alpha_0 + \beta_0 SNAP/WIC + \sum_{1}^{n_1} \beta_{1i}\, Ind_i + \sum_{1}^{n_2} \beta_{2i}\, Fam_i + \varepsilon$$

in which FI is food insecurity; SNAP/WIC is (depending on the model) an indicator of SNAP participation in 1999-2003, WIC participation in early childhood, or an indicator of SNAP/WIC participation; *Ind* is a vector of individual level variables described above, and *Fam* is a vector of family level variables described above. We estimated these models in the full sample, and in a sub-set of only individuals who were low income (and therefore potentially eligible for SNAP) in 1999-2003.

In other models using the same covariates, we included interactions between low-income status and SNAP participation at the three age periods of childhood (SNAP0-5years * LOWINCOME0-5years) (SNAP6-11years * LOWINCOME6-11years) (SNAP12-18years * LOWINCOME12-18years). Again, we estimated these models in the full sample, and then estimated three separate models in which we used the *subpop* command in Stata to examine the effect of SNAP only among those who were eligible to participate in the program. In the first of these models, only individuals who were low income at some point during ages 0-5 years were included and SNAP0-5years was included in the model as were interactions for SNAP participation and low-income status in the other two periods (SNAP6-11years * LOWINCOME6-11years) (SNAP12-18years * LOWINCOME12-18years). In the second model, only individuals who were low income at some point during ages 6-11 years were included and SNAP6-11years

was included in the model as were interactions for SNAP participation and low-income status in the other two periods (SNAP0-5years * LOWINCOME0-5years) (SNAP12-18years * LOWINCOME12-18years). In the third model, only individuals who were low income at some point during ages 12-18 years were included and SNAP12-18years was included in the model as were interactions for SNAP participation and low-income status in the other two periods (SNAP0-5years * LOWINCOME0-5years) (SNAP6-11years * LOWINCOME6-11years). Next, to examine the effect of WIC, we estimated the same logit model as above with WIC and the four-category SNAP/WIC variable in the model as the key independent variable.

To examine the role of parental nutritional knowledge, we added the three-category nutritional knowledge score to the models described above, denoted as NK in Model 2 below. Because nutritional knowledge was measured in 1999, we examined nutritional knowledge in connection with SNAP receipt in 1999-2003 rather than SNAP at different age periods of childhood (Model 2).

$$\text{Model 2: } Logit\ (\pi_{FI}) = \alpha_0 + \beta_0 SNAP + \beta_1 NK + \sum_{1}^{n_1} \beta_{2i}\, Ind_i + \sum_{1}^{n_2} \beta_{3i}\, Fam_i + \varepsilon$$

We then examined the time diary data by adding examining the unadjusted effect of time spent in food shopping, preparation and eating on food insecurity, and gradually building towards the fully adjusted model (Model 3):

$$\text{Model 3: } Logit\ (\pi_{FI}) = \alpha_0 + \beta_0 NK + \sum_{1}^{n_1} \beta_{1i}\, Ind_i + \sum_{1}^{n_2} \beta_{2i}\, Fam_i + \sum_{1}^{n_3} \beta_{3i}\, Time_i + \varepsilon$$

All analyses were conducted with Stata 15. Survey weights were applied with *svyset* commands, and post estimation *margins* commands were also used to generate predicted probabilities of food insecurity.

Results

Characteristics of the study sample are described in **Table 1,** both for the overall sample and by food insecurity status in 2015/2017. Twenty-nine percent of the sample received SNAP at some point when they were aged 0-5 years, 23% received SNAP when they were aged 6-11 years, and 19% of the sample received SNAP when they were aged 12-18 years old.

There are significant differences in the SNAP receipt between the Food Secure and Food Insecure group, which is to be expected, since many of the food secure family units are higher income and would not qualify for SNAP. The same is true when looking at Income, where a much higher proportion of the Food Insecure sub-sample is defined as low income. We also see significantly higher proportions of non-Hispanic black families in the Food Insecure group (27.4% as compared to 14.2% non-Hispanic white). We also see that food insecure family units are less likely to have a college education, more likely to be unmarried, and more likely to be unemployed.

Table 1: Characteristics of the study sample, overall and by 2015/17 food security status

	Overall n= 1,305	**Food Secure n= 939**	**Food Insecure n= 366**
	% (95% CI)	% (95% CI)	% (95% CI)
Total	100	79.3 (72.8, 79.5)	23.7 (20.5, 27.2)
Received SNAP benefits			
in 1999-2003	17.5 (14.0, 21.6)	14.1 (11.1, 17.8)	28.3 (21.1, 36.7)
in 2015	16.5 (14.2, 19.2)	11.3 *8.9, 14.2)	33.4 (27.9, 39.3)
when aged 0-5 years	29.2 (24.7, 34.2)	24.0 (18.9, 29.9)	46.0 (38.7, 53.4)
when aged 6-11years	23.2 (19.1, 27.9)	19.0 (15.1, 23.6)	36.8 (29.0, 45.4)
when aged 12-18 years	18.8 (14.9, 23.3)	14.1 (10.8, 18.2)	33.8 (25.7, 43.1)
Income ≤200% FPL			
in 1999-2003	39.0 (35.1, 43.0)	33.2 (28.9, 37.8)	57.7 (48.7, 66.2)
when aged 0-5 years	49.6 (45.4, 53.8)	44.5 (39.8, 49.3)	66.1 (59.7, 71.9)
when aged 6-11years	44.7 (41.1, 48.5)	39.8 (36.0, 43.6)	60.8 (52.9, 68.2)
when aged 12-18 years	36.7 (31.8, 41.9)	30.9 (26.0, 36.3)	55.3 (47.6, 62.7)
Total family income in 2015 (mean [SE])	$47,589 (1,236)	$53,232 (1,684)	$29,385 (1,999)
Sex			
Male	47.8 (44.4, 51.2)	49.0 (44.8, 53.2)	44.0 (36.7, 51.6)
Female	5.2 (48.8, 55.6)	51.0 (46.8, 55.2)	56.0 (48.4, 63.3)
Age in 2015			
Mean age (mean [SE])	26.0 (0.10)	26.2 (0.12)	25.4 (0.25)
20-25 years	40.8 (36.6, 45.1)	39.3 (34.7, 44.2)	45.5 (37.2, 54.1)
26-29 years	45.4 (40.9, 50.0)	45.3 (40.7, 50.1)	45.7 (38.2, 53.4)
≥ 30 years	13.8 (11.5, 16.6)	15.4 (12.7, 18.5)	8.8 (5.2, 14.4)
Race/ethnicity			

	Overall n= 1,305	Food Secure n= 939	Food Insecure n= 366
	% (95% CI)	% (95% CI)	% (95% CI)
NH White	75.8 (70.3, 80.6)	79.2 (73.4, 84.1)	64.8 (56.2, 72.5)
NH Black	17.3 (13.0, 22.5)	14.2 (10.4, 19.0)	27.4 (19.3, 37.3)
Hispanic	2.5 (1.0, 6.2)	2.7 (1.1, 6.8)	1.6 (0.4, 5.7)
Other	4.4 (2.7, 7.3)	3.9 (2.1, 7.1)	6.3 (3.6, 10.8)
Education			
≤ High school	4.7 (3.5, 6.2)	3.1 (2.0, 4.7)	9.7 (6.9, 13.6)
High school/ GED	28.6 (25.4, 32.0)	23.6 (19.9, 27.9)	44.4 (35.5, 53.7)
Some college	28.6 (25.3, 32.2)	27.1 (23.9, 30.5)	33.5 (25.0, 43.2)
College or higher	38.1 (34.0, 42.5)	46.1 (41.6, 50.7)	12.3 (8.1, 18.3)
Employment status			
Employed	81.1 (78.0, 83.9)	85.0 (81.5, 88.0)	68.6 (62.6, 74.0)
Unemployed	9.0 (7.3, 11.1)	6.2 (4.3, 8.8)	18.3 (14.0, 23.4)
Out of the labor force	6.0 (4.2, 8.4)	4.5 (2.9, 7.1)	10.5 (7.0, 15.6)
Student, not working	3.9 (2.5, 5.9)	4.5 (2.9, 6.9)	2.6 (0.9, 7.2)
Urbanicity in 2015			
Metro	80.9 (76.5, 84.6)	82.0 (77.3, 85.8)	77.4 (69.8, 83.6)
Non-metro	19.1 (15.4, 23.5)	18.0 (14.2, 22.7)	22.6 (16.4, 30.2)
Region in 2015			
Northeast	15.8 (11.7, 21.0)	18.4 (13.5, 24.6)	7.5 (5.2, 10.5)
Central	27.1 (23.0, 31.6)	27.3 (23.0, 32.0)	26.5 (20.3, 33.9)
South	36.6 (32.5, 40.9)	34.1 (29.6, 38.8)	44.7 (37.0, 52.7)
West	20.5 (15.2, 27.1)	20.3 (15.1, 26.7)	21.3 (12.9, 33.0)
Marital status in 2015			
Married	25.1 (21.7, 28.9)	28.3 (24.0, 33.0)	14.9 (9.8, 22.2)
Never married	66.8 (62.8, 70.6)	63.7 (58.8, 68.4)	76.7 (69.4, 82.8)
Divorced, widowed	8.1 (6.1, 10.7)	8.0 (5.5, 11.5)	8.3 (5.0, 13.5)
Parental nutritional knowledge in 1999			
Mean [SE]	3.90 (0.8)	3.99 (0.09)	3.63 (0.14)
Low (0-1)	10.2 (7.7, 13.3)	8.4 (5.8, 11.9)	16.0 (10.5, 23.5)
Medium (2-3)	16.2 (12.7, 20.5)	15.9 (11.7, 21.3)	17.1 (11.3, 24.9)
High (4-5)	73.6 (68.2, 78.4)	75.7 (69.8, 80.8)	66.9 (57.8, 74.9)

Figure 1 shows the transition of food insecurity status between 1999-2003 and 2015-2017. Sixty-four percent of the sample were food secure at both time points, and 7% were food insecure at both time points. Seventeen percent were food secure in 1999-2003 but food insecure in 2015-2017 and 13% were food insecure in 1999-2003 and food secure in 2015-2017.

Figure 1. Food Security Transitions (1999/2003-2015/2017)

Cell percentages		2015-2017		
		Secure	Insecure	Total
1999-2003	Secure	63.6% 757	16.7% 243	80.3% 1,000
	Insecure	12.7% 182	6.9% 123	19.7% 305
	Total	76.3% 939	23.7% 366	100% 1,305

Figure 2 shows the transitions between the full range of food security statuses from 1999 to 2015. Sixty-eight percent of the sample were food 'secure' at both time points, and 7.8% had 'very low' food security at both time points. Of the total sample, 12.8% saw increased food security from 1999-2015, while 29.6% saw declines in food security from 1999-2015.

Figure 2. Food Security Transitions (1999-2015)

		2015				
		Secure	Marginal	Low	Very low	Total
1999	Secure	68.1 627	14.9% 155	9.3% 107	7.8% 79	968
	Marginal	55.0% 76	19.6% 31	15.1% 29	10.3% 15	151
	Low	53.5% 74	17.7% 14	9.7% 13	19.1% 20	121
	Very low	58.0% 21	29.0% 10	5.2% 5	7.8% 3	39
	Total	65.5% 798	15.8% 210	9.7% 154	9.0% 117	100% 1,279

Figure 3 shows the transitions between SNAP participation across age periods during childhood. Fifty-six percent of the sample never received SNAP benefits, and among those who

did receive SNAP benefits, 35% received them at some point during all three age periods (0-5 years, 6-11 years, and 12-18 years).

Figure 3. SNAP Participation among Individuals who Received SNAP 1984-2013

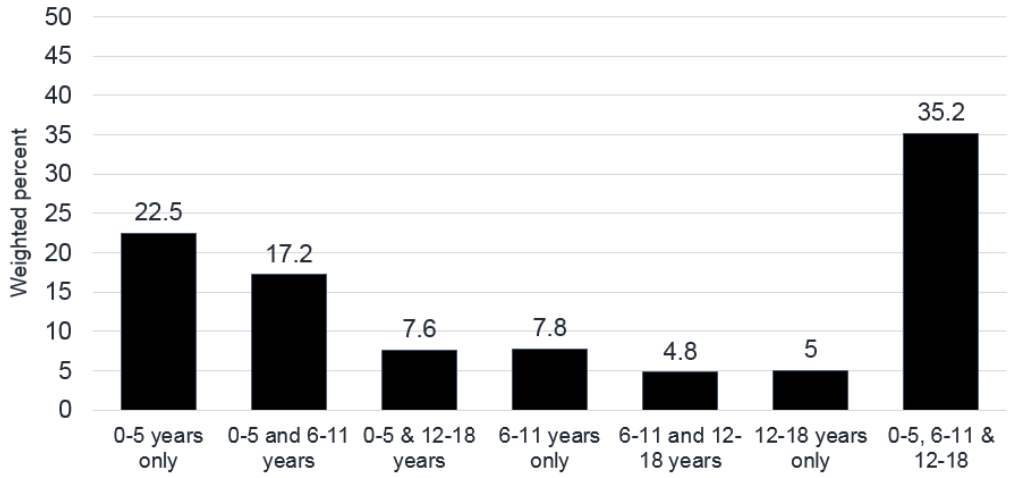


Table 2 shows the results of SNAP participation during 1999-2003 on food insecurity in 2015-2017 for the full sample. SNAP participation, food insecurity or being low income do not statistically significantly increase or decrease the odds of being food insecure. All of the following results are based on logit models using survey weights adjusted for SNAP participation and low income status (as interactions) at other age periods, age in 2015, time since started own household, log of total family income in 2015, gender, race, education, employment status, marital status, region, metro/non-metro, and family unit size in 2015.

Table 2. SNAP Participation 1999-2003 and Food Insecurity 2015-2017

Variable	OR	SE	t	*p*-value	95% CI	
Full sample (N=1,303)						
SNAP participant in 99-03	1.052	0.319	0.17	0.868	0.568	1.950
Food insecure in 99-03	1.123	0.323	0.42	0.680	0.628	2.022
Low income in 99-03	1.289	0.347	0.94	0.353	0.7449	2.230

Table 3 shows the results for SNAP participation during 1999-2003 among individuals who were low-income during that same time period. Again, SNAP participation does not have a significant effect on food insecurity in 2015-2017.

Table 3. SNAP Participation 1999-2003 and Food Insecurity 2015-2017 if Low Income

Variable	OR	SE	t	*p*-value	95% CI	
Low income in 99-03 (N= 645)						
SNAP participant in 99-03	1.111	0.350	0.33	0.740	0.585	2.112
Food insecure in 99-03	1.133	0.380	0.37	0.712	0.572	2.242

Table 4 shows results for the effect of SNAP participation during different ages of childhood on food insecurity in young adulthood using interactions between SNAP participation and low-income at different age periods. We then examined SNAP participation at different age period only among individuals who were eligible for SNAP at that time (**Table 5**).

Table 4. SNAP Participation, Low Income Status and Food Insecurity

	SNAP	No SNAP	Difference	*p*-value
Low income during each age period:				
Age 0-5	24.7	24.6	1.1	0.98
Age 6-11	27.0	25.7	1.3	0.80
Age 12-18	**35.1**	**24.9**	**10.2**	**0.04**

Table 5. SNAP Participation and Food Insecurity by Low Income Status

Variable	Odds Ratio	SE	t	*p*-value	95% CI	
MODEL 1: If low income during ages 0-5 (n=733)						
SNAP age 0-5	1.006	0.300	0.02	0.983	0.548	1.848
SNAP age 6-11 (& low income)*	1.03	0.345	0.09	0.93	0.520	2.037
SNAP age 12-18 (& low income)*	1.415	0.410	1.19	0.241	0.783	2.554
MODEL 2: If low income during ages 6-11 (n= 698)						
SNAP age 0-5 (& low income)*	0.967	0.336	-0.10	0.924	0.477	1.963
SNAP age 6-11	1.087	0.344	0.26	0.794	0.570	2.071
SNAP age 12-18 (& low income)*	1.30	0.402	0.86	0.394	0.697	2.442
MODEL 3: If low income during ages 12-18 (n=607)						
SNAP age 0-5 (& low income)*	1.037	0.307	0.12	0.903	0.568	2.894
SNAP age 6-11 (& low income)*	0.794	0.238	-0.77	0.447	0.430	1.464
SNAP age 12-18	**1.857**	**0.518**	**2.22**	**0.034**	**1.052**	**3.277**

WIC participation during the first 5 years of life shows a protective, but non-significant effect on the odds of being food insecure in young adulthood (**Table 6**). Among low-income families (when the child was 0-5 years old), receipt of both SNAP and WIC benefits showed a small, but non-significant protective effect against food insecurity in young adulthood compared to receiving neither SNAP or WIC, or SNAP, or WIC alone.

Table 6. SNAP and/or WIC Participation and Food Insecurity

Variable	Odds Ratio	SE	t	*p*-value	95% CI	
MODEL 1: Full sample (N=1,303)						
SNAP in 99-03	1.065	0.324	0.21	0.838	0.573	1.979
WIC ever	0.895	0.232	-0.43	0.672	0.529	1.516
MODEL 2: If low income in 99-03 (N= 645)						
SNAP in 99-03	1.158	0.49	0.49	0.629	0.627	2.139
WIC ever	0.721	0.198	-1.19	0.242	0.412	1.261
MODEL 3: If low income during ages 0-5 (n=733)						
SNAP only	1.136	0.525	0.28	0.785	0.443	2.910
WIC only	1.051	0.395	0.13	0.895	0.489	2.261
Both SNAP and WIC	0.955	0.407	-0.11	0.914	0.400	2.278

Figure 4 once again shows the transitions between the full range of food security statuses from 1999 to 2015. The next set of analyses will focus on two outcomes: becoming more food secure from 1999-2015, or becoming less food secure from 1999-2015. Of the total sample, 12.8% became more food secure from 1999-2015, while 29.6% became less food secure from 1999-2015.

Figure 4. Food Security Transitions, More or Less Secure (1999-2015)

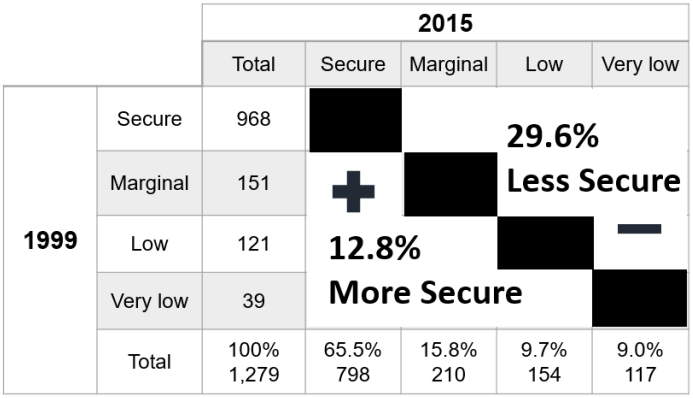


Table 7 shows results for the effect of SNAP participation during different ages of childhood conditional upon being low income on both becoming more food secure (Model 1) or less food secure (Model 2). We find that SNAP participation significantly increases the odds of improved food security in early and late childhood, and that it has no detrimental effects on the odds of being less food secure.

Table 7. SNAP Participation and Food Insecurity Change 1999-2015

Variable	OR	SE	t	*p*-value	95% CI	
MODEL 1: More secure (vs. less secure or no change)						
SNAP age 0-5 (& low income)*	**2.355**	**1.004**	**2.01**	**0.053**	**0.988**	**5.610**
SNAP age 6-11 (& low income)*	0.966	0.374	-0.09	0.930	0.439	2.125
SNAP age 12-18 (& low income)*	**2.675**	**1.179**	**2.23**	**0.033**	**1.089**	**6.566**
MODEL 2: Less secure (vs. more secure or no change)						
SNAP age 0-5 (& low income)*	0.625	0.183	-1.60	0.119	0.344	1.137
SNAP age 6-11 (& low income)*	1.314	0.420	0.85	0.400	0.685	2.519
SNAP age 12-18 (& low income)*	0.867	0.267	-0.46	0.646	0.463	1.624

Table 8 shows the predicted probabilities for the effect of SNAP participation during different stages of childhood conditional upon being low income on both becoming more food secure (Model 1) or less food secure (Model 2).

Table 8. SNAP Participation and Food Insecurity Change, Predicted Prob. 1999-2015

	SNAP	No SNAP	Difference	*p*-value
MODEL 1: More secure (vs. less secure or no change)				
Age 0-5	**13.4**	**6.7**	**6.7**	**0.07**
Age 6-11	13.8	14.1	-0.3	0.94
Age 12-18	**24.4**	**11.6**	**12.8**	**0.07**
MODEL 2: Less secure (vs. more secure or no change)				
Age 0-5	24.1	32.5	-8.4	0.10
Age 6-11	35.3	29.3	6.0	0.35
Age 12-18	30.1	34.9	-4.9	0.41

Table 9 shows results for the effect of SNAP and/or WIC participation conditional upon being low income on both becoming more food secure (Model 1) or less food secure (Model 2).

We find that the combination of SNAP and WIC participation significantly increases the odds of improved food security in early adulthood with a 4.47 higher odds than those who did not receive SNAP or WIC. The combination of the programs appears to have a stronger impact than either of the two programs alone.

Table 9. SNAP and/or WIC Participation and Food Insecurity Change 1999-2015

Variable	OR	SE	t	*p*-value	95% CI	
MODEL 1: More secure (vs. less secure or no change)						
SNAP only	1.965	1.184	1.12	0.270	0.576	6.702
WIC only	1.141	0.494	0.31	0.762	0.473	2.754
Both SNAP and WIC	**4.472**	**1.719**	**3.90**	**<0.001**	**2.044**	**9.783**
MODEL 2: Less secure (vs. more secure or no change)						
SNAP only	0.792	0.280	-0.66	0.515	0.386	1.628
WIC only	0.981	0.288	-0.06	0.949	0.549	1.785
Both SNAP and WIC	0.791	0.279	-0.66	0.512	0.385	1.624

Table 10. SNAP and/or WIC Participation and Food Insecurity Change among Low Income, Predicted Probabilities 1999-2015

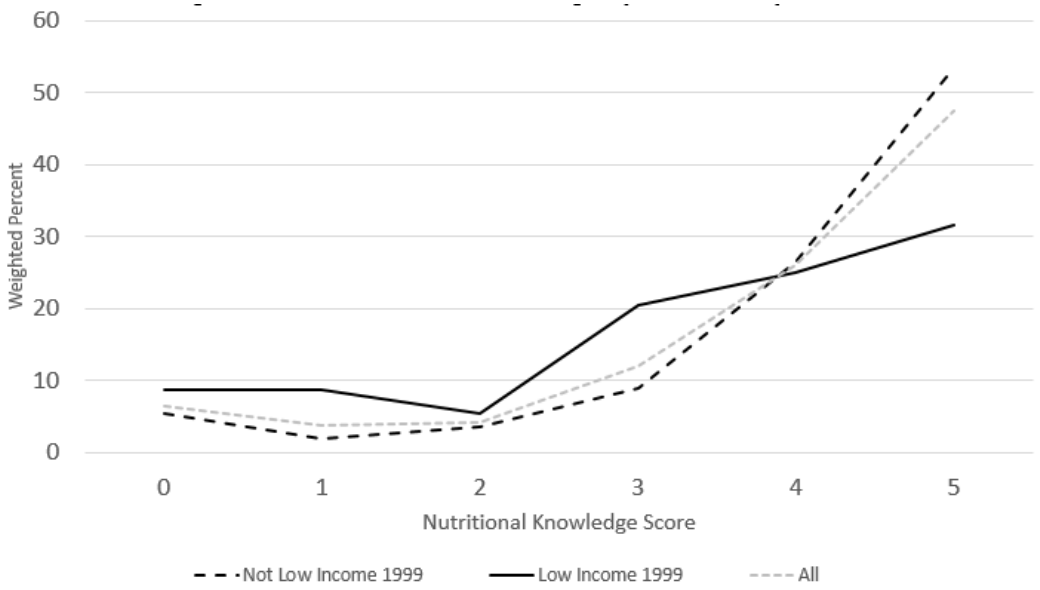
	Predicted Probability	Difference	*p*-value
MODEL 1: More secure (vs. less secure or no change)			
Neither SNAP or WIC	7.4	[ref]	
SNAP only	13.3	5.9	0.30
WIC only	8.4	9.3	0.76
Both SNAP and WIC	**25.0**	**17.6**	**0.001**
MODEL 2: Less secure (vs. more secure or no change)			
Neither SNAP or WIC	38.1	[ref]	
SNAP only	33.4	-4.8	0.51
WIC only	37.7	0.4	0.95
Both SNAP and WIC	33.3	-4.8	0.51

Aim 2: Parental Nutritional Knowledge

Parental nutritional knowledge in 1999 was measured by a score of 0-5, and categorized as low (0-1), medium (2-3), or high (4-5). **Figure 5** shows the distribution of the scores among the study sample overall and stratified by low vs. high income (in 1999). 53% of parents in

higher income families had a nutritional knowledge score of 5 compared to 32% of low-income parents.

Figure 5. Diet Nutritional Knowledge by Total Family Income 1999



Higher parental nutritional knowledge in 1999 was associated with lower risk of food insecurity in young adulthood in single models, but was not statistically significant in the final models. The predicted probability of being food insecure in 2015/2017 was 37% for those whose parents had low nutritional knowledge, 25% for medium, and 22% for high knowledge.

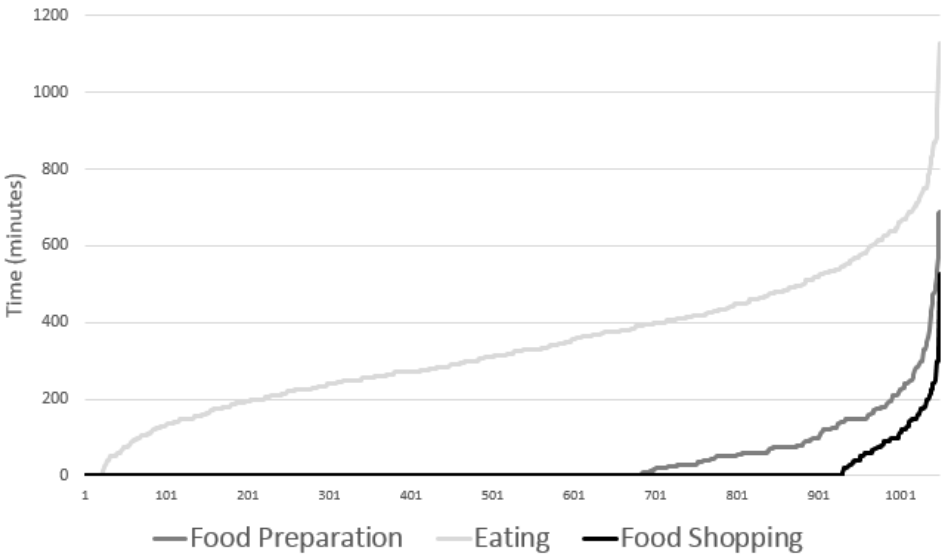
Table 11. Parental Nutritional Knowledge and Food Insecurity

Model Covariates	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
Nutritional Knowledge Score	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Low (0-1)	[ref]		[ref]		[ref]		[ref]	
Med (2-3)	0.56	0.24, 1.34	0.54	0.23, 1.29	0.55	0.23, 1.28	0.60	0.26, 1.39
High (4-5)	**0.46**	**0.25, 0.86**	0.61	0.36, 1.04	0.65	0.37, 1.14	0.79	0.43, 1.44
	None.		Low income status, food security status, SNAP participation (all 1999-2003)		Model 2 plus: parental nutritional knowledge, age in 2015, sex, race		Model 3 plus: launch, education, employment, marital status, metro/non-metro, region, family unit size	

Aim 3. Child Foodways and Food Security

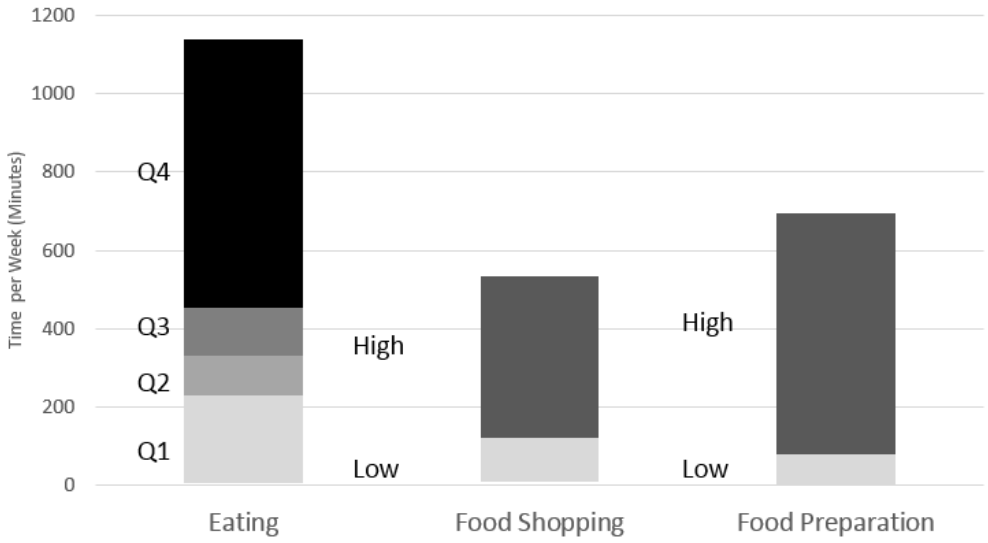
Child foodways are estimated using time spent in an average week doing the following activities: food preparation, eating, and food shopping. This information was taken from the time diary data included in the Original Child Development Supplement. As previously stated, the minutes per weekday and per weekend day were aggregated to obtain an estimated measure of weekly time spent in each activity or set of activities. Figure 6 shows the distribution of time that each child (n=1,049) spent doing each of these activities. Time spent in food preparation and food shopping are left skewed, with the majority of children not recording taking part in either of these activities on the randomly selected weekday or weekend day. Time spent eating varied widely, though all children reported some value of time spent eating. In order to obtain information about children in middle childhood, time diary data was taken from the 1997 time diary for children aged 5 and up in 1997, while those who were below age 5 in 1997 had information pulled from their 2002 time diary when they were age 5-10 years old.

Figure 6. Distribution of Time Spent in Foodways in Minutes (min to max unweighted)



In order to work with the skewed responses to food preparation and food shopping, we generated two categorical variables. Each of these variables was created in the same way, where a value of 0 corresponds to no time spent in the activity, 1 corresponds to being in the lower half of the weighted distribution of those with at least one minute of participation, and 2 corresponds to being in the upper half of the weighted distribution. The 50th percentile for time spent in food preparation was 75 minutes, and 112 minutes for Food Shopping in the weighted analysis. Time spent eating was divided into quartiles, where weights were applied to the sample. Figure 7 shows the distribution of these variables, which are then used in the sub-sample of individuals who completed a time diary.

Figure 7. Food Involvement Variable Distributions (weighted categories)



By including these measures in our full model controlling for all previously mentioned covariates (except childhood SNAP participation), we see a statistically significant protective odds ratio for being in the 'high' group for time spent preparing food. This is significant at the $p<.01$ level, showing that having a high amount of time spent preparing food in middle childhood is protective against being food insecure (low, very low) in young adulthood.

Table 12. Food Preparation, Food Shopping, & Eating and Food Insecurity

Variable	OR	SE	t	*p*-value	95% CI	
Food Preparation Category (ref=None)						
Low	1.095	0.229	0.440	0.666	0.716	1.676
High	**0.432**	**0.120**	**-3.020**	**0.005**	**0.246**	**0.761**
Food Shopping Category (ref=None)						
Low	1.296	0.494	0.680	0.502	0.596	2.818
High	1.462	0.712	0.780	0.441	0.542	3.940
Eating Quartiles (ref=Quartile 1)						
Quartile 2	1.086	0.324	0.270	0.785	0.591	1.995
Quartile 3	1.452	0.377	1.440	0.161	0.856	2.463
Quartile 4	1.725	0.515	1.820	0.077	0.939	3.169

We do not see this protective outcome for time spent Food Shopping or time spent Eating, though we do see marginal significance for food insecurity in young adulthood for those in the highest quartile of time spent eating. This category corresponds to spending between approximately an hour (63.57 minutes) and an hour and forty (107.28 minutes) minutes per day when looking at the weighted quartiles for the 75th and 99th percentiles. The reference group is the lowest quartile, where individuals are spending an average of 8.5 to 32.8 minutes per day eating, when looking at the weighted quartiles at the 1st and 25th percentiles.

Looking at the post estimation predicted probabilities of the fully adjusted models, having spent no time in food preparation and a ‘low’ amount of time are not significantly different, with predicted probabilities of being food insecure in 2015-2017 of approximately 24-25%. However, being in the ‘high’ group for time spent in food preparation shows a significant difference of over 10 percentage points lower, meaning those with a ‘high’ value for food preparation time have a predicted probability of 13.2% for being food insecure in young adulthood (2015-2017).

Table 13. Food Involvement and Food Insecurity Predicted Probabilities

	Predicted Prob	Difference	*p*-value
Food Preparation			
None	23.4	ref	ref
Low	24.8	1.4	0.667
High	**13.2**	**-10.2**	**0.002**
Food Shopping			
None	21.2	ref	ref
Low	24.9	3.7	0.519
High	26.7	5.5	0.462

Discussion

In this project we used data from the PSID's Original CDS to examine whether participating in the nutrition assistance programs SNAP and WIC during childhood protects against food insecurity in young adulthood (in 2015-2017 when individuals in our sample were 20-33 years old). We examined SNAP participation at a point in time (1999-2003) when children in our sample were between the ages of 2-16 years, and also used PSID data from 1984-2013 to examine SNAP participation during different age periods in childhood (0-5 years, 6-11 years, and 12-18 years). We find that SNAP and WIC participation during childhood does not significantly result in lower odds of food insecurity in young adulthood. Though we do find a small protective effect of receiving both SNAP and WIC benefits during ages 0-5 years, that result was also not significant. However, we do find a protective effect of SNAP participation (during ages 0-5 years and 12-18 years) and the combination of SNAP and WIC participation during ages 0-5 years on significantly higher odds of becoming more food secure in young adulthood than one was during childhood.

We also examined the role of parental nutritional knowledge and time spent in food shopping, food preparation and eating activities during middle childhood and how those are related to future food insecurity. We found that more time spent in food preparation led to lower

odds of food insecurity as a young adult. This is consistent with other evidence that strong food preparation skills can be protective against food insecurity among low-income women[26,27] and that participation in cooking and food preparation with parents during childhood is associated with improved dietary habits in young adulthood.[28] We did not see significant differences based on time spent food shopping.. Although we expected that all individuals would report some time eating during the day, whether they spent time in food preparation or food shopping on specific days was uncertain. Food shopping is also an event that does not often happen every day, so the possibility of the two randomly selected time diary days containing food shopping was expected to be lower. That food shopping is not a daily occurrence was reflected in the data.

Since these time diaries were taken during the school year for children of school age, we can expect that the time spent in food preparation would differ between the weekdays where school is in session and the weekend when children are more likely to be at home with their parents. We accounted for this variability by our creation of a weekly measure where the time spent on the weekend was multiplied by two and the time spent on a weekday was multiplied by five.

The finding that experience with food preparation is protective against food insecurity suggests that spending time preparing food in middle childhood, or childhood in general, may indeed equip individuals to better manage food resources and improve dietary quality in young adulthood.

Evidence shows that SNAP is effective at mitigating concurrent or short-term food insecurity.[29] While there has been little research to date examining the long-term impacts of SNAP enrollment during childhood, we had hypothesized that via improved food and economic security in the short-term, longer term risk of food insecurity might also be improved. Although research from Hoynes and colleagues[30] suggests that SNAP participation during childhood is associated with an increase in economic self-sufficiency among women during adulthood, we did not find a similar protective effect of SNAP and WIC participation during childhood on

increased odds of being food insecure during young adulthood. However, we do see a significant effect of SNAP participation during childhood on improved food security status in young adulthood compared to food security status during childhood. The fact that we did not see significantly higher odds of being food secure may be a result SNAP benefits not being sufficient over the long-term to see significant effects on becoming fully food secure. Given evidence to suggest that SNAP benefits do not cover the cost of an average low-income meal and that many SNAP-enrolled families still struggle to afford nutritionally adequate foods,[31] it is possible that although individuals experience short-term improvements in food security, SNAP may not result in large improvements in food security over the long-term.

Limitations

The results presented above should be considered within the context of several limitations. First, food insecurity was only measured in certain data collection waves (1999, 2001, 2003, 2015, 2017) which somewhat limited the analytic strategies that were available to us. We were unable to estimate the fixed effects models we had originally proposed that would allow us to examine SNAP participation during childhood and food insecurity in young adulthood. However, our analytic approach did take advantage of the wealth of longitudinal information for the individuals in our sample (and their families) over an extended time period (1984-2017). We did see substantial transitioning in food security status and SNAP participation between data collection waves, and can only account for some of that movement.

Second, endogeneity is a concern as there may be unobserved characteristics that are associated with SNAP/WIC participation during childhood and lead to food insecurity in young adulthood that we do not account for in our analysis. Third, our measure of nutritional knowledge, while based on questions from DKHS, did not use all of the 7 questions included in the DKHS module. Furthermore, nutritional knowledge was only measured at one time point during which the CDS children in our sample were between the ages of 2-14. There may be

other domains of food and nutrition knowledge that are equally or more important for food security that are not accounted for in our nutritional knowledge measure. Fourth, there was some inconsistency between self-reported SNAP participation and the income data regarding whether or not a household should be eligible to participate in SNAP (based on income). We spent a lot of time and effort to calculate income eligibility for SNAP and low-income status as accurately as possible, but still a non-trivial number of people in our sample classified as having received SNAP were also high income. These same individuals also had much higher food insecurity in 2015-2017. By limiting some of our analyses to only individuals who are low-income (and therefore eligible for SNAP) we address some concerns about potential bias the high-income SNAP participants may introduce to our estimates. Finally, as with all survey research, there may be some recall bias and social desirability bias present that may bias our results.

Future research

There are several areas that future research should pursue. It will be important to examine obesity outcomes[30] in young adulthood, particularly as related to food involvement, using time diary models where we can also control for additional factors that might be important for obesity, but not food security (including sleep and physical activity).

Deliverables

We are currently preparing a manuscript for publication that will be submitted to a public health journal such as *American Journal of Preventive Medicine.* This paper is focused on the parental nutritional knowledge and time diary findings presented here. When that paper is submitted, we will also prepare and submit the SNAP participation analyses for publication, focusing on the transitions to becoming more or less food secure between 1999-2015. We also presented our findings in numerous academic conferences. We presented an oral presentation at the annual

meeting of the *International Society for Behavioral Nutrition and Physical Activity* in Hong Kong in June 2018. This fall, in addition to presenting our findings at the USDA conference in September 2018, we also presented findings from this project at the PSID User Conference in Ann Arbor, MI in September 2018. We also presented our results in a poster session at the annual meeting of the *American Public Health Association* in November of 2018 and at a poster session at the annual meeting of the *Association for Public Policy Analysis and Management* in November, 2018. We will also present two posters from this work at the *Population Association of America* Annual Meeting to be held in April 2019.

Conclusion

In this final report, we presented results from our analyses examining the role of childhood SNAP and WIC participation, parental nutritional knowledge, and childhood food involvement on food insecurity in young adulthood. We find that SNAP participation during childhood (particularly at ages 0-5 and 12-18) shows a protective effect in that individuals who receive SNAP benefits are more likely to become more food secure, than other low-income individuals who do not participate in SNAP. Participation in both SNAP and WIC during ages 0-5 shows even higher odds of becoming more food secure in young adulthood. In addition, high parental nutritional knowledge, and high involvement of food preparation during childhood also are protective against being food insecure in young adulthood. Future research should further investigate the effects of nutrition education, nutrition assistance program participation, and involvement in food preparation on food insecurity over the short and long term.

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